

An Exploration in Computer Science Diversity

An Honors Thesis (HONR 499)

by

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Abstract

The field of Computer Science (CS) has a well known stereotype of being dominated by white and Asian males. As a woman in CS, I wanted to know whether my classmates in the Ball State CS department felt discriminated, uninvolved, or unrepresented, and how they thought diversity could be increased within the department. I conducted a survey and two focus groups to determine the current population of CS students' opinions and feelings on the matter, and found that the main reason for a lack of diversity was misinformation on what CS is.

Acknowledgments

I would like to thank my thesis advisor, David Largent, for helping me through this project and for teaching the classes that made me think about these issues. I would also like to thank C.S. Hendershot for assisting in the preparation and conduction of the focus groups. Finally, I would like to thank the CS students who filled out the survey as well as those who attended the focus groups. Thank you.

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Process Analysis Statement

At first, I was going to do a simple research paper, but in speaking with my advisor, decided to do a survey and focus group, to really discover what current students, specifically at BSU, thought about the state of diversity and inclusivity. We researched how to conduct these and decided on questions to be asked in both the survey and any potential focus groups. In order to do this, my advisor and I met with a representative from the Office of Institutional Diversity. She walked us through the process of getting approval from the institutional review board (IRB) and how to conduct surveys and focus groups. She also put us in touch with a graduate student who helped me decide on what questions to ask and took notes during the focus group meetings. This was a totally new experience for me, and the two of them, along with my thesis advisor, helped make the process both educational and successful.

Once I finished Collaborative Institutional Training Initiative (CITI) training and the study was approved by IRB, we sent out emails to the students in the CS department asking them to participate. I watched the results slowly trickle in and was pleasantly surprised to receive quite a few responses. After the two weeks we gave them to complete the survey, we reached out to those who had indicated they would be willing to also participate in a focus group. To conduct the focus groups, I lead the conversation with questions similar in subject matter to the survey, but generally let the conversation flow. My analysis of the data collected is presented in the following thesis.

An Exploration in Computer Science Diversity

Introduction

As a woman in Computer Science (CS), I am very aware of the lack of diversity; I have never had a class with more than 10% of women classmates and have experienced many classes from which the majority of the women have dropped out. I have taken a few courses which address the lack of diversity but wanted to face it head on. I conducted a survey followed by two focus groups, which asked Ball State Computer Science students how they felt the university, and our Computer Science Department, fared in the way of diversity and inclusion, what they thought the reason for this was, and how it could be best addressed.

According to *Kicking Butt in Computer Science*, “57% of 2012 undergraduate degrees in the United States went to women.” Despite claiming the majority of degree overall, only 14% to 18% of degrees in CS were awarded to females (Frieze). In 2016, only 9.6% of CS degrees were awarded to Hispanic graduates and only 4.9% to Black graduates (“Computer Science.”). In *Stuck in the Shallow End*, author Jane Margolis claims there is a misconception that since computers are so present in modern life, it is assumed those with aptitude for and interest in CS will naturally gravitate towards the field. However, she goes on, because of both the dominance of white and Asian males in the field and schools’ general lack of curriculum, the diversity gap within CS remains (Margolis). So, the questions remaining in my mind were how accurate is this when compared to Ball State and what do my fellow Computer Science students think about diversity?

Research Methodology

I created the questions for the survey, which can be found in Appendix A, based on the information I wanted to analyze. I then had my advisor as well as a volunteer Sociology Graduate Student, look them over and help make any changes they deemed necessary to make things more clear or informative. I administered the survey through Qualtrics and sent invites and reminders through email to preexisting lists of CS majors provided by the CS department. The students invited to participate in the focus groups were those who had indicated via the survey that they would be willing to take part and had provided their names and emails (stored separately from their survey responses). The focus groups, of which there were two, were conducted by me as a discussion with some base questions similar to those included in the survey, with assistance and note taking by the same graduate student who helped improve the survey questions. Each discussion, which took place in a meeting room in Bracken Library, lasted about thirty minutes and included pizza, graciously provided by the CS department.

Survey Results and Interpretation

In the survey I conducted, 73 students started the survey, with 38 completing it, of the 316 students to whom the survey was sent. This represents about 12% of current computer science undergraduates. The breakdown in their years of study is shown in figure 1.

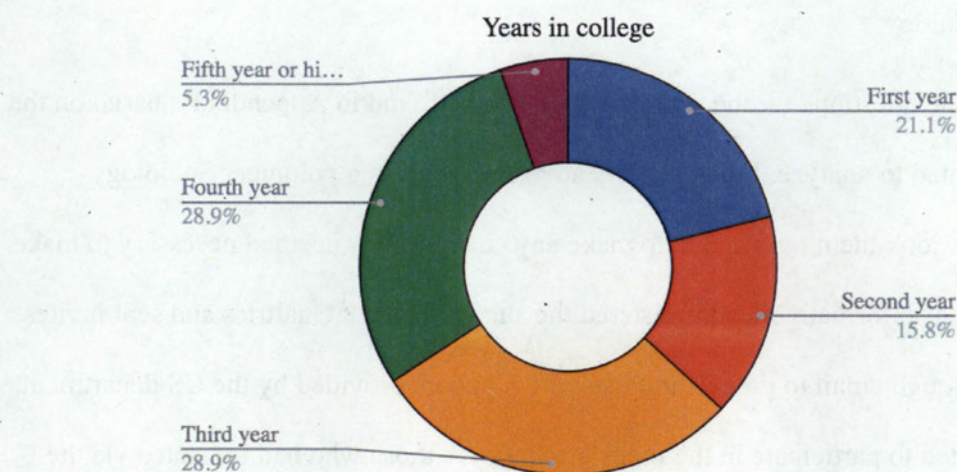


Figure 1: Breakdown of respondents' years in college.

The majority of respondents (81.6%) described themselves as white.

Approximately 7.9% described themselves as black or African American and about 5.3% described themselves as Hispanic or Latino. As a member of the CS department myself, this seems like fairly accurate representation of these ethnicities. However, only one person (2.6%) described themselves as being of Asian descent. The CS department is home to many international students, and there is generally a higher percentage than 2.6% per class. The reason for the low responses from Asian individuals is not clear, but perhaps since the survey was sent via email, there would have been more responses in all demographics had it been mentioned in classes or posters.

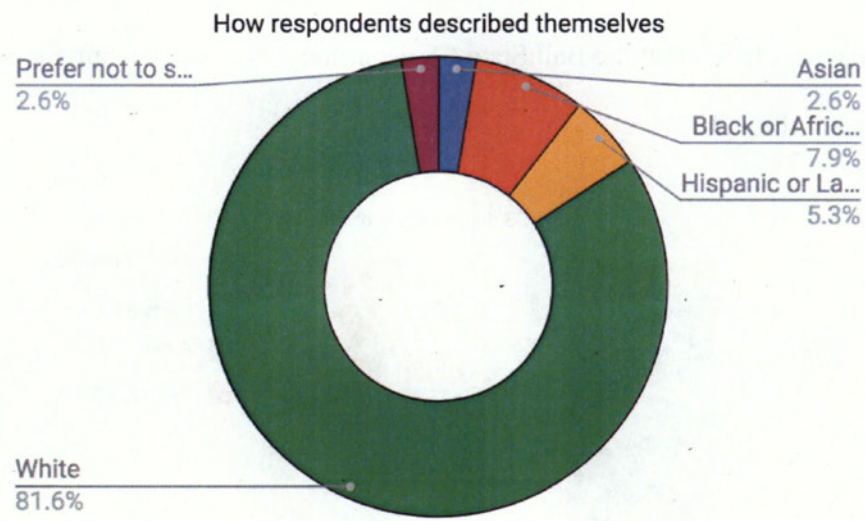


Figure 2: Breakdown of how respondents described themselves.

As was mentioned earlier, my CS classes usually consist of less than 15% women, however, about 34% of the respondents were female.

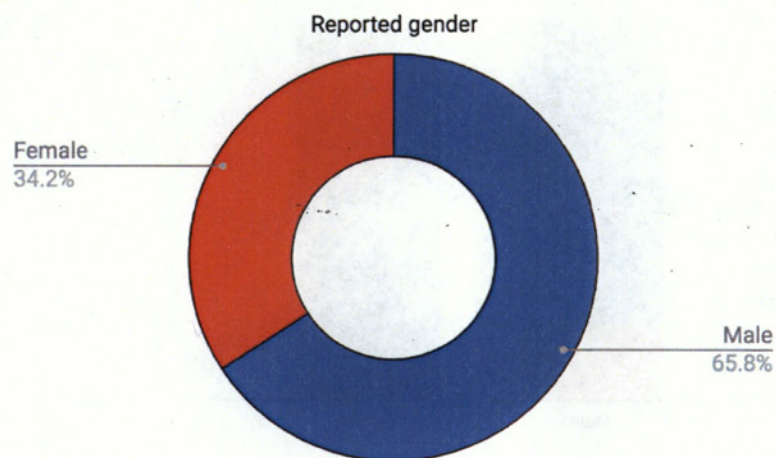


Figure 3: Breakdown by reported gender.

Looking at the responses students gave to questions about the university's diversity and acceptance, most people felt that the Ball State CS department is accepting but not diverse, as shown in Figures 4 through 7.

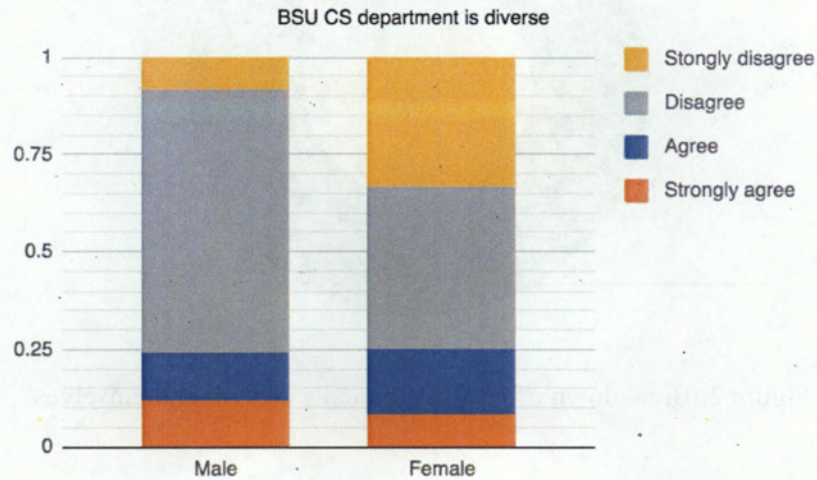


Figure 4: Responses to the diversity of genders within the Ball State CS department

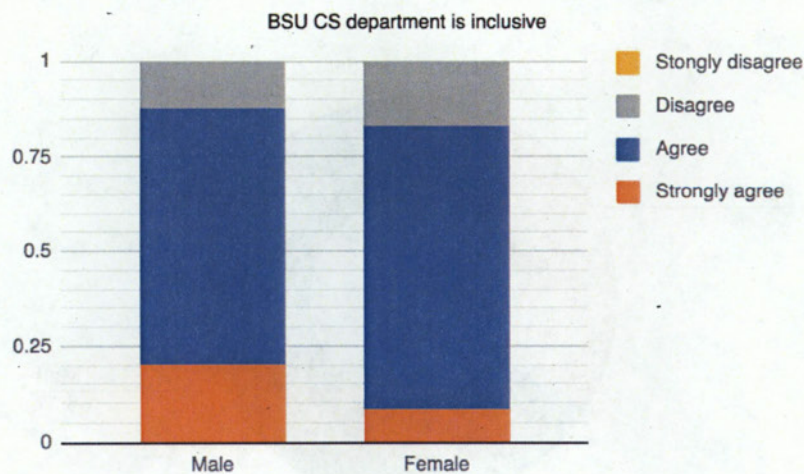


Figure 5: Responses to the inclusion of genders within the Ball State CS department

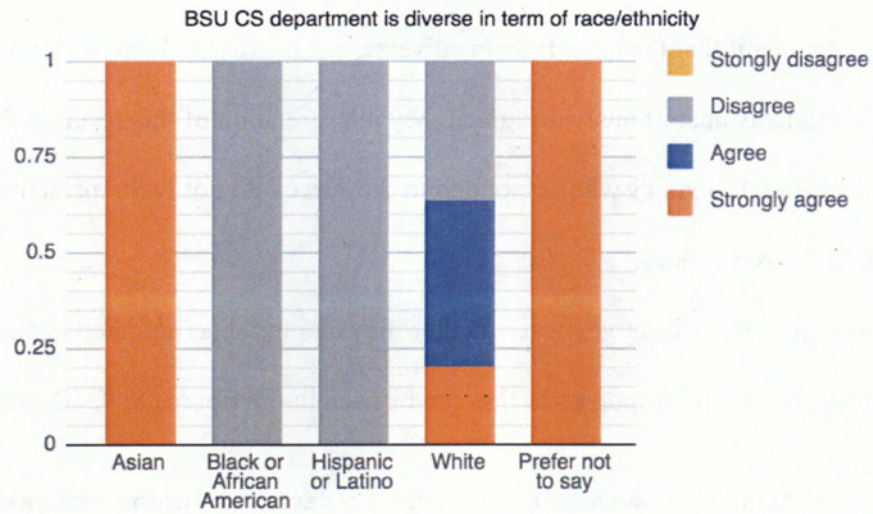


Figure 6: Different ethnicities' responses to the question of how diverse the Ball State CS department is

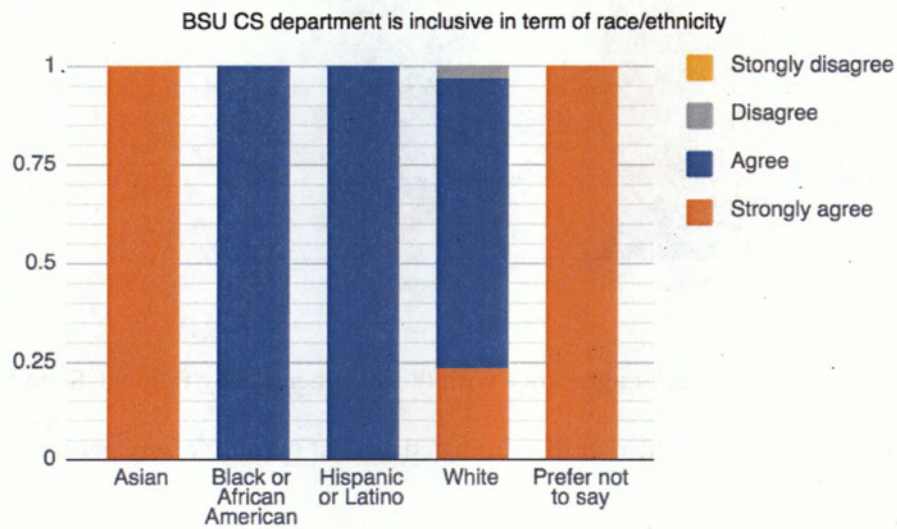


Figure 7: Different ethnicities' responses to the question of how inclusive the Ball State CS department is

One interesting thing to note about the above charts: the person of Asian descent strongly agreed with the statement that the department is diverse, while African American/black and Latino/Hispanic students unanimously disagreed. My interpretation of this result is that the African Americans and Hispanics who responded to the survey do not feel represented in the department while the Asian does.

A question posed in the survey was whether they had felt discriminated against by their classmates or professors. The responses to this can be seen in the figures 8, 9, 10, and 11.

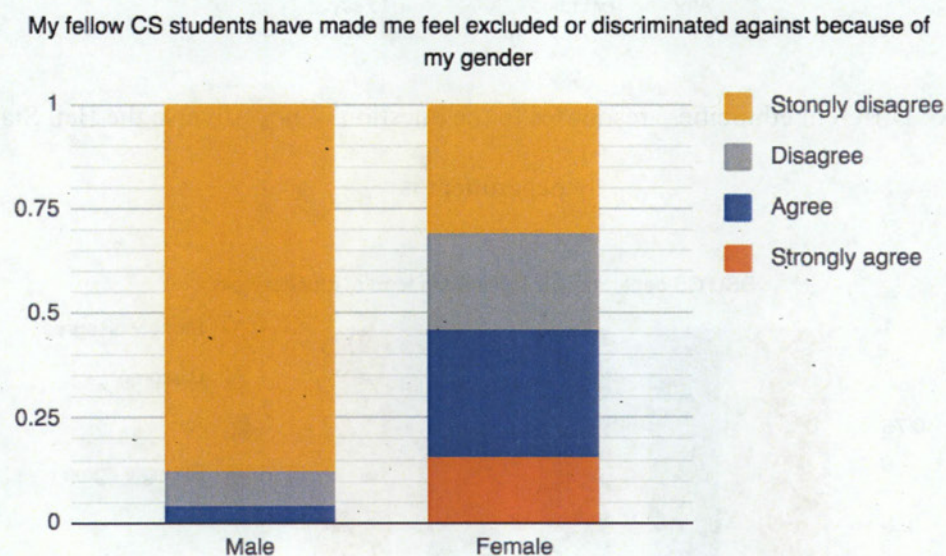


Figure 8: Respondents' level of agreeance with the statement: "My fellow CS students have made me feel excluded or discriminated against because of my gender"

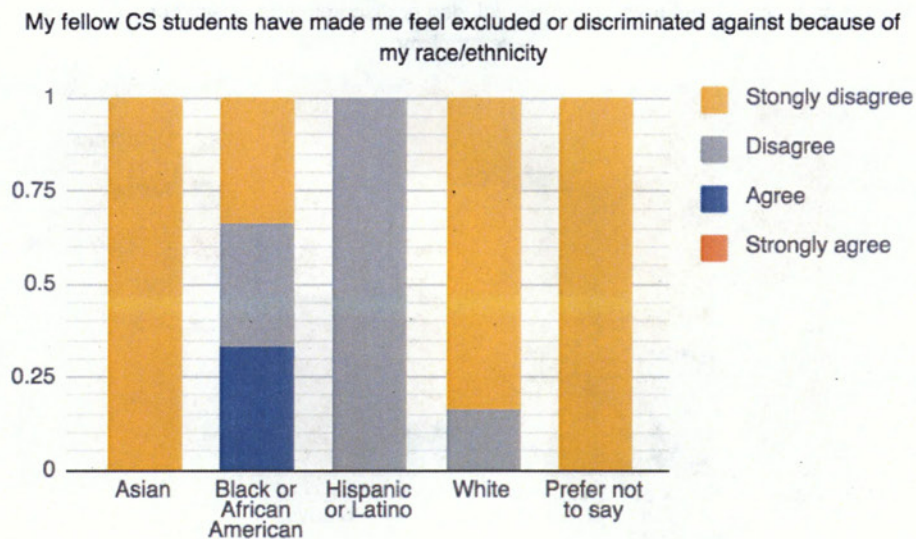


Figure 9: Respondents' level of agreeance with the statement: "My fellow CS students have made me feel excluded or discriminated against because of my race/ethnicity"

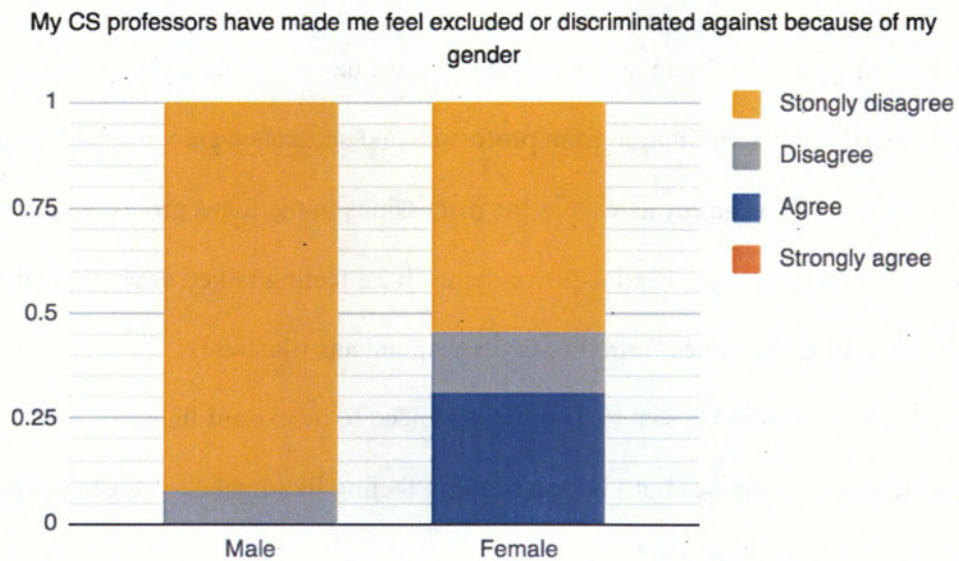


Figure 10: Respondents' level of agreeance with the statement: "My CS professors have made me feel excluded or discriminated against because of my gender"

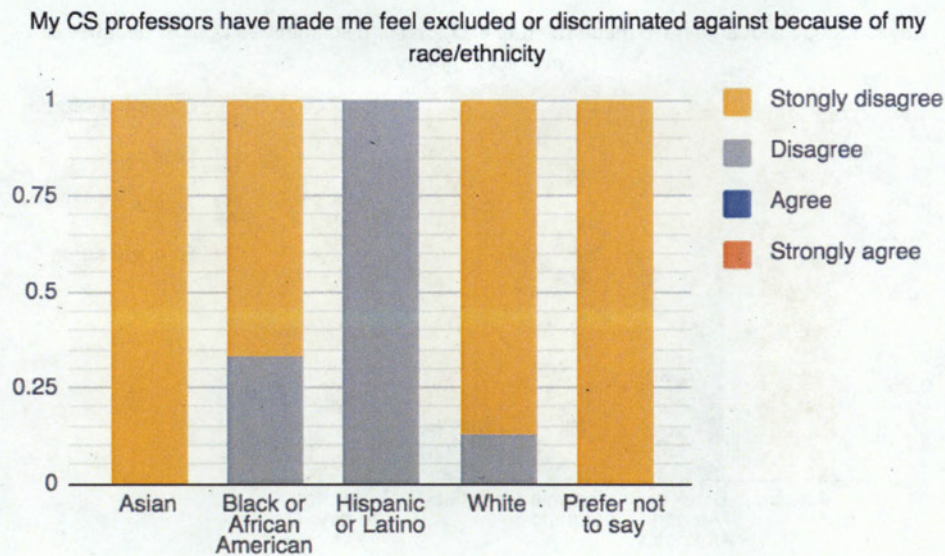


Figure 11: Respondents' level of agreeance with the statement: "My CS professors have made me feel excluded or discriminated against because of my race/ethnicity"

An interesting thing of note here is that the biggest demographic of people who responded they had felt discrimination from professors and students were women. Looking at the short answer portion of the survey as well as the discussions in the focus group, it seems women had a lot to say about feeling the need to prove themselves, feeling talked down to, and feeling excluded, as the following quotes from the survey respondents illustrate:

- "I feel as a woman in CS that to be ordinary I need to be extraordinary. I feel less of this in my upper level classes but I have a nagging feeling like I need to constantly prove that I am in CS because I like it."
- "I've been talked down to in a few of my classes by male students if I didn't understand a concept. I felt that if I was a guy I wouldn't have been treated that way."

- "When I first began in CS I felt excluded, because I am female and the men didn't think I knew what I was doing. I now feel included, because I have proved to them that I can do what they can do."
- "I am an African American female in a predominately white male field. Sometimes I feel as though they feel like I'm unapproachable because they think I may not understand or relate to certain topics."

A large portion of the focus groups was centered on why there is a lack of diversity in CS, and one of the main reasons discussed was imposter syndrome, the feeling that one is not good enough or has to constantly prove themselves, which is reflected in the above quotes. Another person said he felt professors expected students to know about the subjects coming in, even though, as he pointed out, "[many] people do not come from a big computer background." Another big reason is the negative stereotype associated with people in CS. The portrayal in the media is an overweight, male slob, which could deter many people from entering the field. However, according to the discussions in the focus groups, the biggest reason for lack of diversity in CS is a general lack of knowledge about the field. Most of the people at the focus groups, including myself, had a family member or school counselor suggest that they try out a CS class in either high school or college. Before the suggestion, they had little to no knowledge about or exposure to the field.

Solution and Conclusions

The possible solutions from the survey results and focus groups' discussions vary from widespread solutions to changes to be made at our university. One of the biggest problems is the stereotype of who CS majors are, and simply changing this could greatly improve diversity in the field, however that is no small task. Focusing on Ball State, students feel they could benefit from

“a designated support staff member for minorities” or “perhaps study/support groups for minorities.” Students also felt instructors should make more of an effort to make “sure no students are being swept aside or ignored that may have a different gender/race/ethnicity and making sure they have partners they enjoy working with.” Overall though, as the biggest issue discussed was the lack of knowledge about CS, the best solution is to expose high school and even elementary students to what the computer science field is about, and how it could benefit them.

Works Cited

"Computer Science." *Data USA*, datausa.io/profile/cip/110701/.

Frieze, Carol, and Jeria Quesenberry. *Kicking Butt in Computer Science: Women in Computing at Carnegie Mellon University*. Dog Ear Publishing, 2015.

Margolis, Jane. *Stuck in the Shallow End: Education, Race, and Computing*. MIT Press, 2008.

Appendix A - Survey Questions

[Demographic questions]

- What is your gender? Male, Female, Prefer to self-describe, Prefer not to say
- Do you identify as transgender? Yes, No, Prefer not to say
- How would you describe yourself? American Indian or Alaska Native, Asian, Black or African American, Native Hawaiian or Other Pacific Islander, Hispanic or Latino, White, Prefer not to say
- Are you an international student? Yes, No
- What is your year of study? First year, Second year, Third year, Fourth year, Fifth Year or higher, Graduate student

[Strongly agree, Agree, Disagree, Strongly disagree]

- The field of CS is inclusive in terms of gender.
- The field of CS is diverse in terms of gender.
- The BSU CS department is inclusive in terms of gender.
- The BSU CS department is diverse in terms of gender.
- The field of CS is inclusive in terms of race/ethnicity.
- The field of CS is diverse in terms of race/ethnicity.
- The BSU CS department is inclusive in terms of race/ethnicity.
- The BSU CS department is diverse in terms of race/ethnicity.
- The field of CS is more diverse than most other fields.
- The BSU CS department is more diverse than most other departments at the university.

- My fellow CS students have made me feel excluded or discriminated against because of my gender.
- My fellow CS students have made me feel excluded or discriminated against because of my race/ethnicity.
- My CS professors have made me feel excluded or discriminated against because of my gender.
- My CS professors have made me feel excluded or discriminated against because of my race/ethnicity.

[Open Ended]

- Please indicate if you feel included or excluded within the CS department, and describe why you feel this way.
- Please provide a description of any incidents (without providing names) in which you have felt excluded or discriminated against within the CS department because of your gender, race, or ethnicity.
- Please provide a description of any incidents (without providing names) in which you have felt excluded or discriminated against outside of the university in the field of CS (internships, jobs, etc.) because of your gender, race, or ethnicity.
- What thoughts do you have on how the BSU CS department could better include, support, and/or represent your gender/race/ethnicity?

[Focus Group]

Would you be willing to consider taking part in a focus group with the researcher? (Pizza will be provided!) (Yes/No)

If Yes, please provide us with your email so we can reach out to you about taking part in the focus group. [This will be collected separate from the survey data.]

Appendix B - Focus Group 1 Notes

Introductions:

New they loved technology and took a beginning course

Could easily work from home and make a lot of money family member recommended

2nd Question

2 min

Thought about switching during internship. Made them feel like they weren't going to succeed

Always thought they would stay in CS. Got first internship in interview

3:54

1: Think there is mostly a problem with older people that think it's a men's field

2: Agrees with culture fit. Learned from internship, but feels that they are disadvantaged because they are a girl. She feels that she has to prove herself. People separate in class in early courses, guys group with guys and leave out girls.

Feels it's about stereotypes, but they dissolve once people work with each other

8:00

How do you feel we can combat that?

2: Assign partners in lower classes so that they can break up groups. Teachers are separating classes by putting girls with other girls.

1: Same situation in my classes. Teachers need to not put the same genders together in groups.

Advertise towards females. Usually advertisements for CS have men

10:20

Looking at data...people don't feel the department is diverse but is inclusive

1: I would say department is diverse but not inclusive. Knows men that are not inclusive to women in the department but it's hidden.

2: I would agree it's hidden. Many people don't want to be in groups with foreign people.

12:00

Teaching CS in early grades

2: I think it would help, because it introduces children to the area and gets them thinking about it

1: I think that's why there are more females in the field now

13:20

Do you think faculty inclusive?

2: As a whole, yes.

13:55

Any other thoughts about the survey

NO

Do you think outside workshops would help?

1: Yes, I think it would help, especially for people that are still exploring

2: Agrees

16:00

Specific instance:

2: When a female would ask a question, a teacher wouldn't answer and would shove it off, but if a guy would ask, they would help. It was hard to get help because it seemed that they felt that the girls were stupid.

1: I hear sexist comments from students, sometimes faculty...but don't really feel like that portrays what they really mean

18:50

1: I like working with diverse groups of people. You get different ideas from different people

2: I agree diversity is good because we all come from different backgrounds and we can bounce off different ideas.

20:20

1: It's the idea that you are both willing and accepting of other people...you need to be able to pick up how to work with them as well. You're constantly trying to accept other people and trying to work with them.

2: You have to be open to working with other people. You have no say over who you are working with.

1: Inclusion is when you break that barrier and you start to just be normal around them.

2: The field is more inclusive almost because it has to be, it's part of your job. You have to take people's idea and include them and trust them. Whereas in school, you can kinda say no to others and less inclusive. Even as an intern I have felt equal

1: I would say for me, in my internship, I was quite a few years younger. It was a transition to not be working with peers, but it was never really an issue. They didn't talk down to me or anything. They were testing me, but weren't harming me.

Appendix C - Focus Group 2 Notes

Introductions

What does diversity and inclusion mean to you

1: People coming from different background.

2: A lot of times we think of race and ethnicity, but there's a lot more than just that like different perspectives

1: Yeah I haven't thought about age.

3:00 What do you think about inclusion?

1: Obviously, being included. I kinda take inclusion to another level. I just want to be part of everyone else

2: I agree. Also accessible for other people too in terms of physical ability. It's important to have an inviting environment

3:50 What made you go into CS

1: I took an AP computer science class. My counselor recommended it to me because I didn't know what I wanted to do. I was bad at first but I loved the challenge. It drew me to that. I picked up a minor in spanish

2: I choose CS because I kept messing up my computer all the time and I always had to fix it because my parents couldn't. They said I was good at it so I took some classes on computers. I liked the challenge and stayed to push forward in it because of the careers available. I can do

more with it compared to a field like English. I've considered dropping a lot. I felt at times I wasn't adequately prepared, that it was too hard, I'm not good enough.

1: For me I definitely juggled around my minors but not my major.

6:30 Looking at the data from survey....feel that major is inclusive but not diverse

1: It's hard to do that bc you want to compare to other programs. I think it's way more diverse than other places at Ball State. I feel inclusive

2: I'm not sure in terms of diversity, but I kinda feel there is a mix. There are a lot of opportunities and the door is always open to people of all types of backgrounds. I feel like I see a lot of minorities, especially international, but if we are talking about domestic, there's not a lot of diversity. Like there's not a lot of women, I feel like it's grown.

1: Age, I haven't seen a lot...but we do have some people of different ages which has helped a lot to work with people with different perspectives. It will help in the workforce

9:15 Internships

1: I've worked with Digital Corps and company in indianapolis. Work environment was very diverse and surprised. There were more men, but a lot of women on a team. Also a good mix racially. Because it was an indy company, I thought there were going to be more local people.

2:

11:00 idea of how we can increase diversity?

1: CS department does well with diversity and inclusion. I liked the paired programming in one class. We were forced to partner with someone which is a good step to meeting someone

different. I never would have gone into CS if I did not know about it. A lot of minorities don't have the opportunities to learn about it. I think that would bring numbers up in STEM fields.

2: I think it's reaching out to students in a younger age and reaching out to a certain demographic and just having the opportunity to learn about it. Having more options is always good. I had no interest before.

14:00 How do you feel the image of someone in CS is portrayed

1: Stereotypically, men, quiet, introverted

2: stereotypical nerd, introverted, socially awkward, gamer. That's how you see it on tv. That's how people interpret it from the media.

15:22 How can we change that?

1: I feel like it's a hard thing to change. I feel like those types of kids are the type to go into CS. With more resources and more kids realizing that it's what they want to do, I think it might mellow out.

2: I feel as I've been getting further, I feel like in the beginning classes I see more of that stereotypical person. I feel like I'm seeing more of a mixture of people as I'm getting further. I think to change that perspective, If you show more of the work that CS people do, that will help fight that stereotype. It's more than just the big programming.

17:30 CS standards in schools

1: I think it would help a ton because growing up I didn't have anything integrated in my education. I see my younger cousins playing around with things and they may not understand it, but they are getting that experience. If you don't have that experience, it's just this black box.

2: We have a lot of CS classes in my school but they weren't talked about unless you sought them out. No one ever pushed people to take these classes.

1: I think people get frustrated really quickly but you have to learn to push forward through these things.

21:00 Experiences in classes

1: Peer pairing program is great, but there's also negatives. If you switch up enough partners, I think it's a very inviting way to make the class inclusive. To be able to take a little bit about what I know and what you know.

2: I didn't think about it that way, but that makes sense because I didn't really know anyone so it was a great opportunity to network and get to know others. I know people didn't like this, but there was a professor that had women work with women and men with men. I kinda liked working with other girls, but there was some push back by other people and what they were comfortable with.

23:00

1: CS222 was the biggest wake up call. The biggest aspect I took was the failure part. You're going to fail a lot. Really got me into the mentality that you're going to fail a lot and revise and keep going.

2: I haven't had any internships or experience, but that's definitely true. I think it's important, a lot of people don't have that experience of working with someone for an extended time. Yeah you'll have some ups and downs if someone isn't helping, but outside of the classroom, you're not going to just turn in something quickly and be finished.

1: My group was diverse and everyone worked a little differently and being able to figure out how to work with everyone really helped. If you're going to be successful you have to find that perfect combination of working together as a group.

2: Kinda reflecting on that, I was working with two international students. That was a fun experience because when I go into something I have a set way of doing it and they challenged that.

30:00 Any other comments

1: I feel like when I was growing up, I really missed out on having the opportunity to learn about CS. I just wish I could have had that opportunity when I was younger. The US encourages CS for a lot of people, but we don't really go about it in a good way. I think giving that opportunity to everyone would really bring diversity to CS

2: I agree, I also think there needs to be some way that makes sure people are staying in CS. I feel like I see a high dropout rate and leaving the major. There was a specific group of people, women minorities, a lot of them switched major or disappeared. I feel like they would have stuck with it but felt that the first part was too hard or that they weren't good enough. I wish there was something advisors could do to help them stay.

1: I agree, I found myself in the same position, but it was talking to older people in the field to know that this is normal.

1: I think the university has resources that would help these people, like mentorships to help guide someone.

1: Reminds me too of Club Code Smash(?) that was a good initiative because it brought together older and younger people.

2: That's actually how I networked a lot in the beginning, with older students. These programs are really hard to find unless someone invites you. It would help if those opportunities were published more.

1: Overall, positive experience with department

2: I don't think there are any incidents. I don't ask for help, but when I have asked for help, my profs have been understanding and have helped a lot.

1: In terms of diversity in the classroom, that extends to the instructors too. We have profs from all sorts of background which helps with inclusion. I think that's a key component too

2: I just remembered that for a couple classes people would say stuff about instructors accents. I've heard some rude comments. I accepted it naturally at first and thought later that that wasn't nice. For me, with my experience with international students. I feel like people come from background with not a lot of resources, they may need that additional help, but I've also seen internationally students that have a lot of advantages...It just depends on the individual and their situation.



Office of Research Integrity
Institutional Review Board (IRB)
2000 University Avenue
Muncie, IN 47306-0155
Phone: 765-285-5070

DATE: March 12, 2018
TO: Rachel Harvey
FROM: Ball State University IRB
RE: IRB protocol # 1206655-1
TITLE: An Exploration in Computer Science Diversity
SUBMISSION TYPE: New Project
ACTION: APPROVED
DECISION DATE: March 12, 2018
REVIEW TYPE: EXEMPT

The Institutional Review Board reviewed your protocol on March 12, 2018 and has determined the procedures you have proposed are appropriate for exemption under the federal regulations. As such, there will be no further review of your protocol, and you are cleared to proceed with the procedures outlined in your protocol. As an exempt study, there is no requirement for continuing review. Your protocol will remain on file with the IRB as a matter of record.

Exempt Categories:

	Category 1: Research conducted in established or commonly accepted educational settings, involving normal educational practices, such as (i) research on regular and special education instructional strategies, or (ii) research on the effectiveness of or the comparison among instructional techniques, curricula, or classroom management methods.
X	Category 2: Research involving the use of educational test (cognitive, diagnostic, aptitude, achievement), survey procedures, interview procedures or observation of public behavior
	Category 3: Research involving the use of educational test (cognitive, diagnostic, aptitude, achievement), survey procedures, interview procedures, or observation of public behavior that is not exempt under category 2, if: (i) the human subjects are elected or appointed officials or candidates for public office; or (ii) Federal statute(s) require(s) without exception that the confidentiality of the personally identifiable information will be maintained throughout the research and thereafter.
	Category 4: Research involving the collection of study of existing data, documents, records, pathological specimens, or diagnostic specimens, if these sources are publicly available or if the information is recorded by the investigator in such a manner that subjects cannot be identified, directly or through identifiers linked to the subjects.

	Category 5: Research and demonstration projects which are conducted by or subject to the approval of Department or agency heads, and which are designed to study, evaluate or otherwise examine: (i) public benefit or service programs; (ii) procedures for obtaining benefits or services under those programs; (iii) possible changes in methods or levels of payment for benefits or services under these programs.
	Category 6: Taste and food quality evaluation and consumer acceptance studies, (i) if wholesome foods without additives are consumed or (ii) if a food is consumed which contains a food ingredient at or below the level and for a use found to be safe, by the Food and Drug Administration or approved by the Environmental Protection Agency or the Food Safety and Inspection Service of the U.S. Department of Agriculture.

Editorial Notes:

1. Exempt status (Category 2) with signed consent for focus group participants

While your project does not require continuing review, it is the responsibility of the P.I. (and, if applicable, faculty supervisor) to inform the IRB if the procedures presented in this protocol are to be modified or if problems related to human research participants arise in connection with this project. **Any procedural modifications must be evaluated by the IRB before being implemented, as some modifications may change the review status of this project.** Please contact (ORI Staff) if you are unsure whether your proposed modification requires review or have any questions. Proposed modifications should be addressed in writing and submitted electronically to the IRB (<http://www.bsu.edu/irb>) for review. Please reference the above IRB protocol number in any communication to the IRB regarding this project.

Reminder: Even though your study is exempt from the relevant federal regulations of the Common Rule (45 CFR 46, subpart A), you and your research team are not exempt from ethical research practices and should therefore employ all protections for your participants and their data which are appropriate to your project.

D. Clark Dickin, PhD/Chair
Institutional Review Board

Christopher Mangelli, JD, MS, MEd, CIP/
Director
Office of Research Integrity